# CEMENTATIONS IN NORTHWESTERN SOUTH DAKOTA

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## INTRODUCTION

Many sediments and sedimentary rocks contain accretionary structures, such as concretions, nodules, geodes, and spherulites, which are segregations of the rarer constituents of the rock. The most prevalent of these is the concretion, which is usually composed of the rock's cementing material, and may contain a large portion of original rock material.

## CEMENTATIONS

In most cases, those large concretions in semi-consolidated sandstones and siltstones, which carry over 50% rock material are actually locally cemented portions of the rock, and represent incomplete diagenetic cementation. These structures are distinctly different from other accretionary structures by this higher content of rock material and larger size. These differences, the writer believes, do not warrant their classification as concretions, but rather as an intermediate step between accretionary bodies and well-cemented strata. It is proposed therefore, that these intermediate structures be called **cementations,** a term indicative of their nature.

Then, by definition, cementations are large sub-spherical, lenticular, or irregular shaped (long axis parallel to the bedding) cemented portions of a semisconsolidated sandstone or siltstone with not more than 50% cementing material (usually calcite).

As has been mentioned previously, cementations represent the intermediate step in the diagenetic cementation of the medium grained clastics. Thence, the formation of a cementation bears a close resemblence to the cementing of clastic materials. This process is the deposition by precipitation of minerals (generally calcite or silica) in the interstices of a sediment. The cementing is controlled by the permeability and porosity of the host rock and the availability of cementing materials. The latter may be introduced from an outside source by the way of meteoric or connate waters; may come from the sediment itself in trapped connate water; or by ground water solution and redeposition of sediment material (i.e. shells).

The formation of cementations would follow this same process. In most cementations, the deposition of the cement starts at a point and progresses outward in all directions forming sub-spheroidal to lenticular structures, which in some instances show well-developed concentric layering.



## EXAMPLES

The uppermost Cretaceous and lower Tertiary non-marine sandstones in northwestern South Dakota are characterized by numerous cementations. Attention was first called to these structures in 1896, when Todd (1) described some from the Laramie (Hell Creek) beds of Ewing Co. (now Harding Co.). The general characteristics of these strata are summarized in Table I.

**TABLE I**

**STRATA CHARACTERISTICS**

| | | |
|---|---|---|
| TERTIARY | **Tongue River formation** | Principally cross-bedded subgraywacke sand with abundant calcareous cementations and interbeds of silt, clay, and peat-clay. Several lignite beds. |
| | **Cannonball formation** | Clay, sand, and silty sand with abundant dense limestone concretions. Some calcareous sandstone ledges. Marine invertebrate fauna. Inter-fingers with upper Ludlow. |
| | **Ludlow formation** | Interbedded and lensing greywacke sands, silts, and some clay with many calcareous cementations. Local cross-bedding and ripple marks. Several lignite horizons. |
| CRETACEOUS | **Upper Hell Creek formation** | Interbedded and lensing greywacke sands, silts, and bentonitic clay with ironstone concretions and occasional calcareous cementations. Local peat-clay horizons. |
| | **Lower Hell Creek formation** | Interbedded and lensing greywacke sands, silts, bentonitic clays, and peat-clays. Lignite horizon in upper portion. Dinosaur bones. Marine invertebrates near base. |

The lower part of the upper Cretaceous Hell Creek formation is essentially devoid of these structures, but the sands of the upper part contain a few scattered calcareous cementations. They are usually lenticular or log-like and up to 8 feet in the maximum dimension. They are found in sand and sandy silty strata.

The next younger formation, the Paleocene Ludlow formation contains many lenticular calcareous cementations. These vary greatly in size; generally from 20 feet to 3 feet in their largest dimension, although some are as much as 70 feet in length. The best examples are found on Hump Butte and along U. S. Highway 12 between McIntosh and Thunder Hawk. They occur in a buff medium sand, thin-bedded, and locally cross-bedded. The cementations generally occur in lenses from several

inches to several feet thick, but some are elongate and lobate masses, and others subspheroidal. In most, the two largest dimensions are parallel to the stratification.

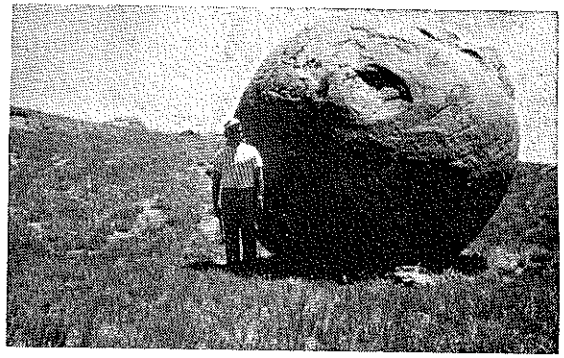

**Figure 1. A large spherical cementation in the Tongue River formation. NW¼, NE¼, Sec. 6, R. 17 E., T. 22 E., Perkins County.**

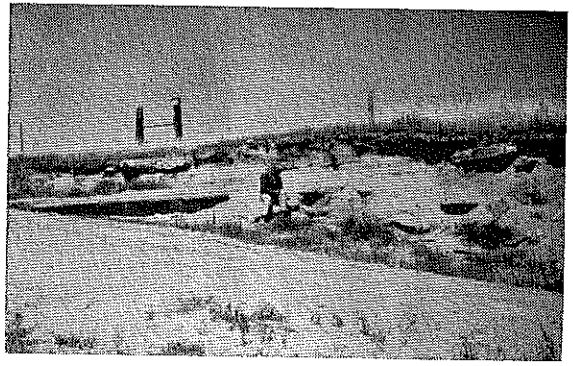

**Figure 2. Lenticular cementations in the Tongue River formation along a section line between Secs. 28 and 33, R. 14 E., T. 23 N., Perkins County.**

Numerous calcareous cementations are characteristic of the Tongue River formation. They occur in a multitude of shapes: tabular, spheroidal, subspheroidal, tear drop, and even dumb-bell shaped. Sizes of the cementations, based on the long diameter, range from 16 to 3 feet, but most vary from 12 to 6 feet. Generally the long diameter is parallel to the bedding. The strata containing these cementations are buff and reddish, medium to fine grained, thin-bedded sands. Cross-bedding is commonly seen. The best exposures are found on the ridge between Thunker Hawk and Lemmon, where there is a great variation in shape. This ridge is crossed by U. S. Highway 12.



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1. Todd, J. E., Log-like Concretions and Fossil Shores. Amer. Geol. **17**, 347-349 (1896).